MI 0175

A Low-β, High Dispersion Insert for the Recycler Ring

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In order to be able to use "Palmer Cooling" to cool the $\overline{p}$ in the Recycler Ring [1] it is necessary to have a region of the ring, perhaps a meter or more long, with a large dispersion, η and a small β. The design objective is to have $\eta/\sqrt{(\beta)} \geq 3m^{1/2}$. I have designed an insertion which satisfies this requirement and which will fit into the 138.309m long MI30 straight section. At the midpoint of the insertion $\beta \approx 1.5m$ and $\eta \approx 3.7m$.

The design of the insertion is such that β_{min} and η can be varied more or less independently. Unfortunately the insertion will not fit into the MI tunnel. The large value of η is produced by bending magnets which displace the beam by several meters. Though the original closed orbit is restored, over a length equal to the length of the bending magnets ($\approx 40m$ in the current design) the beam will displaced by an amount equal to the maximum dispersion or $\approx 3.7m$.

The design has a maximum β within the insertion of $< 200m$ and this should not produce any special problems.

The large dispersion is obtained by putting dipoles with a large bend between the low-β quadrupoles. (In this design I have used a quadrupole doublet.) There are four equal strength dipoles, two on each side of the the low-β point. If, for example, the first dipole bends the beam *out*, then the second and third dipoles bend the beam *in*, and the fourth dipole again bends it *out*. The net result is that. after the four bends, the beam has been

[1] Fermilab Recycler Ring: Technical Design Report, April 1996, Revision 1.0

restored to its original orbit and direction. In the dipole magnets however, the beam has made a rather large excursion from the original orbit.

The path length of the $\overline{p}$ through the dipoles means that the path is increased by $\approx .7m(\approx 2.33ns)$ compared to a particle bypassing the high dispersion/low-β insert.

The enclosed figures show the lattice functions, computed using MAD, in the insertion. Since the insertion is matched, the lattice functions outside of the insertion, are the same as those given in the note "Recycler Ring Lattice Design" by Dave Johnson.

The following tables gives the approximate strengths of the elements in the insertion.

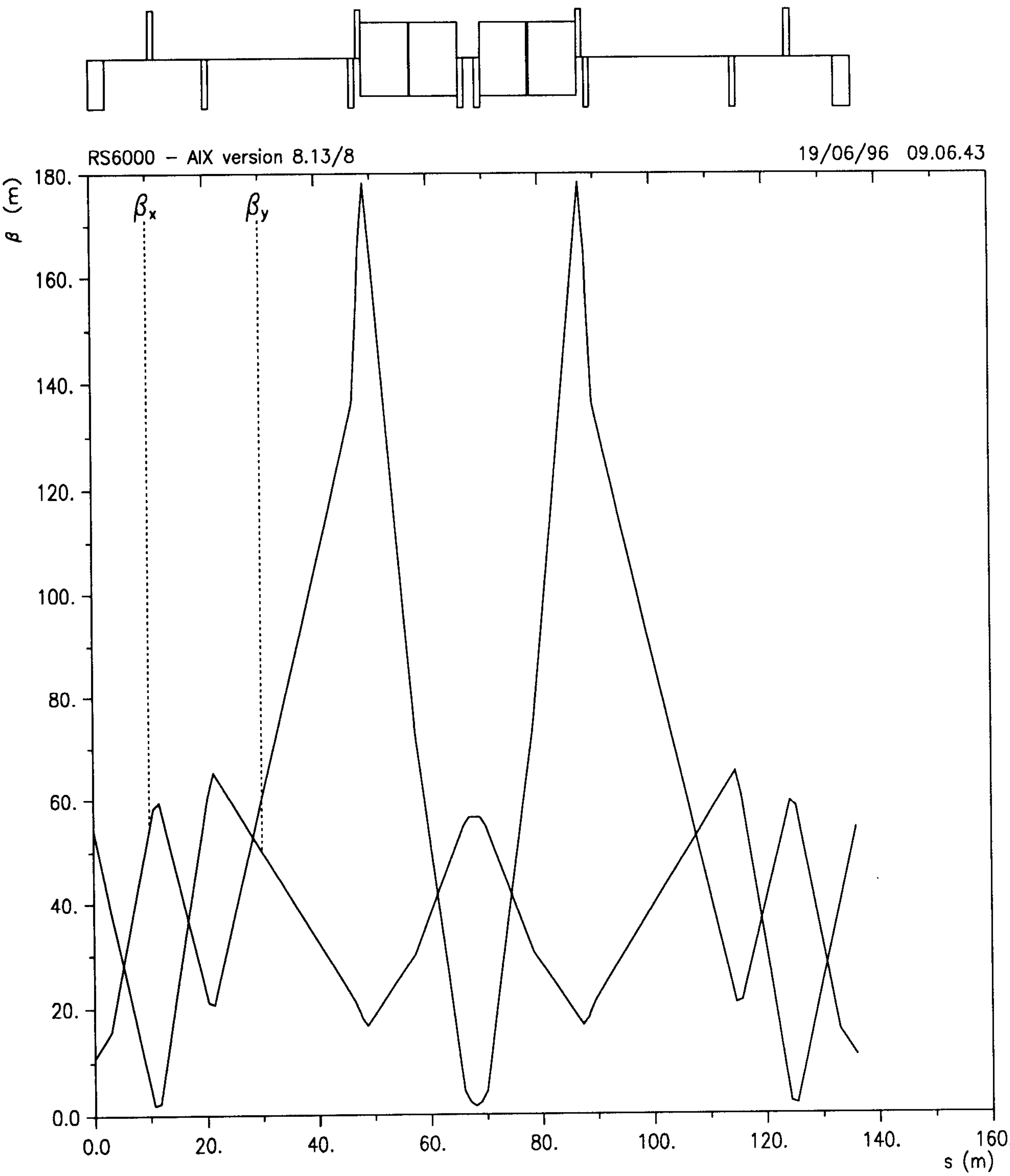
$[B\rho] = 29.64990$

Table 1 Horizontal Bends

Element	Length	Strength
bhlbdp	8.50000 m	1.74411 T
bhlbdm	8.50000 m	-1.74411 T

Table 2 Quadrupoles

Element	Length	Strength
qflbdd1	1.00000 m	3.39059 T/m
qdlbddd	3.00000 m	-1.10951 T/m
qdlbdd2	1.00000 m	-3.58695 T/m
qdlbdd3	1.00000 m	-2.63258 T/m
qflbdd4	1.00000 m	3.89880 T/m
qdlbdcg	.99998 m	-.96313 T/m



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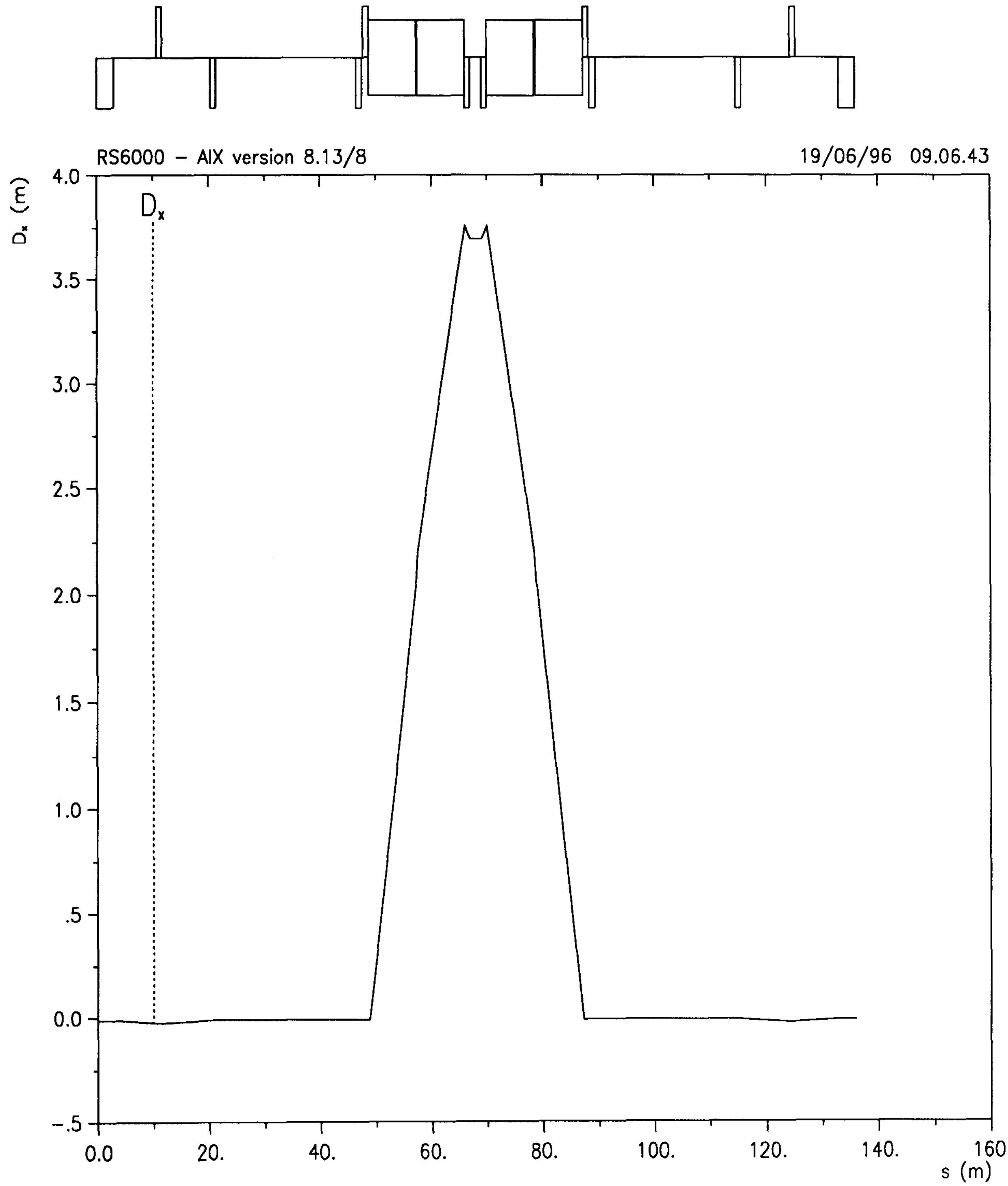

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